

Whether the hoped-for 6000 visitors (paying, we presume, a franc each) per half-hour night and day will visit it and help to provide the sinews of war is another matter.

NORMAN LOCKYER.

GEOLOGICAL SURVEY OF THE UNITED KINGDOM.¹

REPORTS of the progress of the Geological Surveys in India and Canada have already been noticed in NATURE. The report of our home survey has since been issued by the Director-General, Sir Archibald Geikie. It is more voluminous than those of the other countries, and appears rather to be a full record than a "Summary" of the observations made during 1898 by the staff of the Survey. Whatever may be said concerning the state of our knowledge of geology in England and Wales, in Scotland and in Ireland, it cannot be gainsaid that very much remains to be done both from a scientific and a purely economic point of view. The report before us is a striking testimony to this, and when we consider the limited staff and poor equipment of our Survey, it is surprising how much has been done to further the progress of knowledge.

So far as the main field-work of the Geological Survey is concerned, the mapping of entirely new areas has been confined to the mountainous regions of Scotland and to the islands of Arran, Jura and Skye; but it is not in these areas alone that fresh observations of striking importance have been made. Re-surveys are being made of the coal districts of South Wales, North Staffordshire, Leicestershire and South Derbyshire; of the mineral districts of Cornwall and Devon; and of the agricultural districts of the southern and midland counties. In all these cases the work done actually amounts to a new survey, on a larger scale than the original map, and carried out with that attention to minute accuracy which nowadays is absolutely essential. Revisions have also been made in the Silurian areas in Ireland.

A glance at the little index-maps which accompany this report show how much field-work yet remains to be done. Of the 131 sheets of the Scottish one-inch map, fifty-nine only have been published. In England and Wales ninety-nine only of the 360 one-inch new series maps have been published. It has long been recognised that for practical purposes a survey on a scale smaller than six inches to a mile is of little value. The work of the Survey has for many years been conducted on the larger maps, MS. copies of which are deposited for public reference in the Survey Offices in London, Edinburgh and Dublin. In illustration of certain mineral areas and other regions, a number of six-inch maps have been published, but the issue of further maps was some few years ago discontinued, mainly, we believe, on account of the expense of engraving. Cheaper processes, however, are available, and it is to be hoped that the publication of six-inch maps may ere long be resumed. It is not only in mineral areas that these maps are utilised—they are quite as necessary in inquiries relating to water-supply, sanitary engineering, and agriculture. In these important questions the highest attainable accuracy is as necessary as in mining questions. Those who compare the earlier published one-inch maps with the new series of geological maps in England and Wales will recognise the great advances which have been made in the method of mapping, and if these again are compared with the six-inch maps (e.g. of the South Wales coal-field) it will be seen how much work is lost or obscured in the small one-inch reproduction. This difference was strikingly shown in the one-inch and six-inch maps of the Durness area in Scotland, published a few years ago.

¹ "Summary of Progress of the Geological Survey of the United Kingdom for 1898." Pp. v + 216. (London: Printed for H.M. Stationery Office, 1899.)

The present "Summary," like the first of the series which was issued a year ago, is arranged stratigraphically, commencing with the Pre-Cambrian and continuing to the Recent deposits; it contains also records of new railway-cuttings and well-borings, and accounts of the microscopic and chemical work carried on in the Petrographical Department and of the varied work performed in the Palæontological Department. Brief notice is also taken of the numerous public and private inquiries made at the offices of the Survey, work which increases from year to year, as help and advice in reference to water-supply, soils, sites for houses, building-materials, various ores and minerals, are as far as possible freely given to those who seek them.

That the field-work of the Survey must be conducted on a strictly scientific basis is not to be questioned. Economic results must follow, and they may not always be apparent at the time of the survey. It is, however, satisfactory to find that discoveries of importance have been made.

The puzzling question of the age and origin of the Highland schists continues to attract a large amount of attention. The evidence gathered tends to show that the "Moine-schists" of the north-west highlands are metamorphosed arkoses, sandstones, and argillaceous rocks, and that there is unconformity between them and the older (Archæan) gneisses. Associated with the schists are several types of foliated igneous rock, and these in some cases were intruded into the original sediments before their present foliated structures were developed. The Dalradian or so-called Younger Schists of the central highlands have also received much attention, and structures similar to those seen in the Moine Schists have been recognised in these rocks in the Braemar area. What is termed the "hornfels" type of alteration, producing a cordierite-hornfels, has been found where the old granites, such as that of Ben Vuroch, were intruded prior to the movements causing schistosity. This type of metamorphism is not observed in connection with later granitic intrusions, such as those of Cairngorm and Lochnagar. Interesting observations are made on the intrusions of these younger granites, and it is inferred that in the case of Cairngorm the mass, on its southern side, took the form of a cake or sill with vertical or highly inclined edges. The metamorphic changes produced in the bordering rocks by the masses of granite and by various igneous dykes are fully dealt with.

The Cambrian limestones in Skye have yielded a number of fossils which connect them with the Balnakiel and Croisphuil groups of Durness. Several of the species occur also in Newfoundland—and these indicate a horizon below the Arenig formation.

Analyses have been made of Cambrian dolomites from Skye and Durness.

Among the Silurian rocks in Ireland several horizons have been determined by means of Graptolites and other fossils. It is observed that the older rocks of the south-eastern portion of that country have undergone much crushing and deformation, and in the Ribband Series (of Arenig age) the grit-bands are curiously broken up, portions of grit having been pushed into the argillaceous strata so as to produce a brecciated appearance, deceptively like that of a conglomerate; indeed, some of these crush-breccias have actually been described as conglomerates. From the Upper Silurian rocks of Central Scotland a new genus of fishes (*Ateleaspis*) is recorded, and also a new species of *Eurypterus*.

Observations are made on the Old Red Sandstone of Caithness, Ross-shire, the Lorne, and South Wales. In the Lorne district a fish-bed has been discovered on the mainland shore of Kerrera Sound, about three miles south of Oban. The volcanic rocks in the Lower Old Red Sandstone form a conspicuous feature in this region.

Particular attention has been given to the granites of Ben Cruachan and Glen Etive, and it is noted that the porphyrite dykes and sills so numerous in the Cruachan granite are entirely absent from the Glen Etive mass. The evidence tends to show that the chronological order was (1) Ben Cruachan granite, (2) Porphyrite dykes and sills, and (3) Glen Etive granite and quartz-porphyry dykes and sills. It is observed that the huge granitic mass of Ben Cruachan affords special facilities for the study of the phenomena of contact-metamorphism, of which particulars are given. A careful study was made of the Cordierite-bearing rocks which occur among the altered sediments at the back of Loch Awe Hotel, and the discovery in them of Corundum is noted and discussed.

Among the Devonian and older slaty rocks of Devon and Cornwall and the associated eruptive rocks much interesting work is in progress.

In Carboniferous regions the chief work has been done in the coal-fields of South Wales, North Staffordshire and Leicestershire; and there are some new observations on the volcanic rocks in the Carboniferous Limestone of Somerset.

The changes which take place in the Carboniferous Limestone series of Glamorganshire are duly noted, and we have some account of the Millstone Grit and its beds of "silica stone," from which the celebrated Dinas fire-bricks are made. The faulted anticlinal disturbances of the Vale of Neath and Cribarth are described and illustrated. A study of these disturbances is of the highest practical importance, an instance being given where the Pennant escarpment exhibits a gentle and uniform dip, while the soft Lower Coal-measures below are thrown into sharp folds. Explorations are now showing that the lower measures are too much crushed and broken over considerable tracts near the head of the Rhondda valleys for their coals to be workable, though the Pennant rock overlying them is unbroken. Reference is made to the anthracitisation of the coals which proceeds from the eastern side of the South Wales coal-field in a direction somewhat west of north. It is remarked that the lower seams of the north crop in the Vale of Swansea are true anthracites, while one seam becomes a steam-coal at Resolven, and is intermediate between a steam-coal and an anthracite at Crynant. Of the Neath seams, one alone is a house-coal, all the others being steam-coals, although they correspond to the Llantwit group, the most noted house-coals of the coal-field. No connection has been traced between the anthracitisation and the faulting of the district, but the change seems rather to be a form of regional metamorphism dependent upon the temperature to which any part of the coal-field has been subjected during depression, as was suggested many years ago by De la Beche. The results of further investigations on this subject will be looked for with interest, for although much has been done by local observers, the question can only be solved by patient detailed and continuous mapping, and the tabulating of evidence over a large area.

In the North Staffordshire coal-field much has been done to determine and map in detail the main subdivisions of the Coal-measures. The uppermost division, known as the Keele series, comprises a considerable thickness of red sandstones, marls, and occasional bands of corstone—beds formerly regarded as Permian, but now recognised to be strictly conformable to the Upper Coal-measures. Some of the red marls in this series contain plants of Coal-measure species, and it is remarked that the division cannot be classed with the Permian formation of Lancashire and the north-eastern counties. It remains to be proved how far it corresponds with the Supra-Carboniferous or Permo-Carboniferous division which is engaging much attention on the continent and in other regions abroad. It is remarked that the determination of the horizons in the Coal-

measures may prove to have an important industrial and commercial bearing. The fact that the limestone-bands of Newcastle-under-Lyme lie at the base of a group of grey Coal-measures, intercalated between an upper group of red strata (Keele Series) and a lower group of red strata (Etruria Marls), has enabled the survey to detect true Upper Coal-measures in Keele Park, Shutlanehead, and to the west of Leycett; and there seems to be little doubt that the Coal-measures of the Pottery Coal-field lie not far from the surface under Little Madeley and Craddocks Moss. Evidence has been obtained that the strata on the north-west side of the North Staffordshire anticline do not uninterruptedly descend beneath red rocks (so-called Permian) to the west of Leycett, but rise locally westward under Hayes. The effect of this change of inclination is to bring to the surface strata which lie considerably below the unproductive red series, and to bring the principal coals and ironstones within reach further west than might have been expected. Iron-ore has been discovered in the Fenton Park Clay-pits. It is a spheroidal siderite yielding 38.7 per cent. of metallic iron. This may prove to be of considerable importance.

A small patch of Carboniferous rocks has been determined at the Bridge of Awe, in the Lorne area, a fact interesting in connection with the discovery, made many years ago by Prof. Judd, of Carboniferous rocks on the east shore of the Sound of Mull, near Ardtornish. Further evidence of Lower Carboniferous rocks in Arran has also been obtained.

Brief observations on Permian rocks in Leicestershire and in Arran are recorded, and there are fuller notes on the Trias (including the Rhætic Beds) in South Wales, and on the Trias of the Midland Counties and Skye. Short notes again are given on the Lias of Glamorganshire, but the only reference to the Oolites is in a note of a deep boring (439 feet) at Oxford. We hope to hear more of this boring, as it is stated to pass from Inferior Oolite into Lower Lias with no evidence of Upper and Middle Lias, which outcrop at Fawler, near Woodstock.

The Cretaceous rocks have received attention in the southern and eastern counties. There are notes on Chalk inliers which form remarkably bold features in the neighbourhood of Cranborne Chase. There are detailed accounts of the Lower Greensand series of Norfolk, but these facts, which convey much new information, have now been printed in full in the Geological Survey memoir on "The Geology of the borders of the Wash." It is mentioned that the name Selbornian, from Selborne in Hampshire, is proposed as a term for the Gault and Upper Greensand, formations which have long been held to be portions of one stage, although it is useful and necessary on geological maps to separate the clayey Gault from the sandy Upper Greensand. The Selbornian stage will include the Red Chalk of Norfolk, Lincolnshire and Yorkshire, as well as the Gault, and the sands Malmstone and Chert-beds of the Upper Greensand. Where fully developed it is divisible into four palæontological zones, in descending order: (4) zone of *Pecten asper* (as usually known), which would more conveniently be called the zone of *Holaster fossarius*; (3) zone of *Ammonites rostratus*, with its local sub-zone of *A. varicosus*; (2) zone characterised by *Ammonites lautus*, *A. denarius*, and *A. interruptus*; (1) the zone of *Ammonites mammillatus*.

The observations on Tertiary strata refer to Bagshot Beds, and to records of new wells at Mundesley and North Walsham which passed through Pliocene strata as well as Glacial Drift. More important are the researches on the volcanic rocks of Skye, which tell of the numerous sills of basalt and diabase which have been intruded into the basaltic lavas. Though the lavas are older, these sills are younger than any of the great plutonic intrusions of gabbro and granophyre. Reference

is made also to the presumably Tertiary granite of Arran, whose intrusive character was so clearly appreciated more than a hundred years ago by Hutton.

The Pleistocene notes include some general remarks on the method of investigation of the deposits of this and Recent ages. These notes are followed by an excellent account of the Drifts near Uttoxeter. It is remarked that the prevalent drift of the higher ground is a red sandy loam, or more rarely clay, containing numerous rounded quartzite and other pebbles mainly derived from the Bunter. Evidence was obtained that in spite of its general resemblance to rain-wash the material is the local equivalent of the true boulder clay, and has had a similar derivation from the moving mass of land-ice by which the whole country has been covered. It is remarked that the movement of the ice has not been determined by the shape of the ground in the vicinity, nor by the presence of the elevated Carboniferous Limestone tract of the Weaver Hills, but has been consequent upon the pressure of the great ice-sheet which was piled over the lower ground to the westward and north-westward. The occurrence in new localities of marine shells in the Drift of North Staffordshire is likewise noticed. Further particulars are also given of the Glacial Drift in South Wales. The height to which this extends seems limited only by that of the ground. Not only till with glaciated boulders, but numerous striated rock-surfaces have been observed at heights ranging up to 2000 feet on the Old Red Sandstone. In the Isle of Man the Glacial series has been found by a deep boring to be of unusual thickness, apparently descending to between 470 and 500 feet below sea-level.

From various parts of Scotland observations on the Drifts are recorded. In Aberdeenshire there is evidence of the occurrence of blocks of the Glen Derry diorite on the hillside above Allanmore, at a distance of more than six miles to the south-east of the parent-mass. These blocks could not have been brought to their present position by the later or local glaciation, but must have been transported by the ice-sheet over ridges nearly 3000 feet in height. In Inverness-shire the high-level terraces of fluvio-glacial gravel have been traced to an elevation of 1020 feet. Many observations have been made on the Drifts in Ross-shire and in the Black Isle. Again, in Skye it has been observed that at the epoch of maximum glaciation only the highest summits of the Cuillins stood above the ice. This is true also of Blaven, and probably of the Red Hills, though the crumbling granite of which these latter are composed is not so well fitted as the gabbro to retain evidences of glaciation.

In the southern counties of England, as well as in Scotland and Ireland, various notes have been made on Pleistocene and Recent deposits, on the "Head," clay-with-flints, raised beaches, sand-dunes, peat and other accumulations.

The new railway-cuttings which have been examined are those made by the Great Western Railway Company between Stert, near Devizes, and Westbury, in Wiltshire, and those between Wootton Bassett, in Wiltshire, and Patchway, in Gloucestershire. Cuttings on the Great Eastern Railway between North Walsham and Mundesley are briefly noted.

In this abbreviated account of some of the leading observations recorded in the "Summary of Progress of the Geological Survey for 1898," we have sufficiently indicated the work that is being done, and which we hope will be carried on until the whole country has been mapped as carefully as possible on the six-inch scale. Until that work is accomplished, it can never be considered that the more pressing work of the Survey has been carried out. Regarding this as necessary, and looking to the work already performed, it is not to be denied that a very great deal of the more important work of the Survey has yet to be done. This

remark applies, not only to the maps, but to the explanatory memoirs so needful in illustration of each map. The list of publications which is appended to the report before us shows that a number of new memoirs have been issued, while others are in progress; and it is hardly necessary to add that the surveying alone will not supply the public needs if the maps are not accompanied as soon as possible with the memoirs which describe the facts and explain the structures depicted on the maps.

SIR RICHARD THORNE THORNE, K.C.B.,
F.R.S.

SANITARY science has suffered a severe loss by the death, on Monday, of Sir Richard Thorne Thorne, K.C.B., F.R.S., principal medical officer to the Local Government Board. As a guardian of the public health, he was largely responsible for the security of the United Kingdom against serious epidemics, and for the introduction of sanitary measures which have resulted in a diminution of mortality; and as an investigator he made numerous important contributions to the science of preventive medicine.

Sir Richard Thorne Thorne was born at Leamington on October 13, 1841, and was therefore fifty-eight years of age at the time of his death. From an obituary notice in the *Times* the following particulars concerning his career have been derived. He received his medical education at St. Bartholomew's Hospital, and obtained the membership of the Royal College of Surgeons in 1863. In 1866 he became M.B. of the London University, taking a double first class, and for a short time he held some hospital appointments in London; but about 1870 he accepted office in the Medical Department of the Privy Council, which was afterwards transferred to the Local Government Board. In this capacity he continued for many years to discharge the routine work of the office, in the way of inspections and reports, until 1885, when his mastery of the French language led to his selection as delegate of the British Government at a first International Sanitary Conference, which was held at Rome, and was followed by others at Venice, Dresden and Paris. In these conferences he took from the first a leading part, and was mainly instrumental in convincing the representatives of other Governments of the futility of quarantine and of the facility with which, notwithstanding the presence of infectious disease, commerce might be liberated from vexatious restrictions which had previously hampered it. In this way he became a conspicuous public benefactor, not of this country alone, but of many others; and he was appointed her Majesty's Plenipotentiary for signing the Sanitary Convention of Dresden in 1893 and that of Paris in 1894. He early received the distinction of C.B., and that of K.C.B. was conferred upon him in 1897, soon after he had succeeded the late Sir George Buchanan as the head of his department. He was a Crown member of the General Medical Council, vice-president of the Epidemiological Society, Fellow of the Royal Society and of the Royal College of Physicians, LL.D. of Edinburgh, Doctor of Science of the Royal University of Ireland, and held numerous foreign distinctions. Apart from his many official reports relating to the public health, he was the author of works on the progress of preventive medicine during the Victorian era (1887), the "Milroy" lectures on the natural history and prevention of diphtheria (1891), and of the "Harben" lectures on the administrative control of tuberculosis (1898).

By these and other publications Sir Richard Thorne Thorne assisted scientific progress, and improved the conditions of public health. The influence of his works on national sanitation will long be felt.